NRC SEIS Table 7.3-1 Background WQ Parameters and Indicators for Operational Groundwater Monitoring

**Table 7.3-1. Background Water Quality Parameters and Indicators for Operational Groundwater Monitoring***

| Test Analyte/Parameter | |
|---|---|
| Bulk Properties | pH<br>Total Dissolved Solids (TDS)<br>Conductivity |
| Cations/Anions | Bicarbonate Alkalinity (as $CaCO_3$)<br>Calcium, Ca<br>Carbonate Alkalinity (as $CaCO_3$)<br>Chloride, Cl<br>Magnesium, Mg<br>Nitrate, $NO_3$ (as Nitrogen)<br>Potassium, K<br>Sodium, Na<br>Sulfate, $SO_4$<br>Total Alkalinity (as $CaCO_3$) |
| Trace Metals | Arsenic, As<br>Barium, Ba<br>Boron, B<br>Cadmium, Cd<br>Chromium, Cr<br>Copper, Cu<br>Fluoride, F<br>Iron, Fe<br>Lead, Pb<br>Manganese, Mn<br>Mercury, Hg<br>Molybdenum, Mo<br>Nickel, Ni<br>Selenium, Se<br>Silver, Ag<br>Uranium, U<br>Vanadium, V<br>Zinc, Zn |
| Radionuclides | Gross Alpha=Alpha Particles<br>Gross Beta=Beta Particles and Photons<br>Radium, Ra-226 |

*All metals analyses are for dissolved metals.
Source: NRC (2003); Powertech (2011).

1 pH
2 TDS
3 Conductivity
4 Bicarbonate
5 Calcium
6 Carbonate Alkalinity
7 Chloride
8 Magnesium
9 Nitrate
10 Potassium
11 Sodium
12 Sulfate
13 Total Alkalinity
14 Arsenic
15 Barium
16 Boron
17 Cadmium
18 Chromium
19 Copper
20 Fluoride
21 Iron
22 Lead
23 Manganese
24 Mercury
25 Molybdenum
26 Nickel
27 Selenium
28 Silver
29 Uranium
30 Vanadium
31 Zince
32 Gross Alpha
33 Gross Beta
34 Radium -226

NRC SER Table 5.7-2: List of Baseline Parameters

**Table 5.7-2: List of Baseline Parameters**

| | Major Ions | Trace and Minor Elements | Radiological Parameters |
|---|---|---|---|
| 1 | Alkalinity | Arsenic | Radium 226 |
| 2 | Bicarbonate | Barium | Gross Alpha – Total |
| 3 | Carbonate | Boron | Gross Beta – Total |
| 4 | Sulfate | Cadmium | |
| 5 | Chloride | Chromium | |
| 6 | Nitrate | Copper | |
| 7 | Sodium | Fluoride | |
| 8 | Calcium | Iron | |
| 9 | Magnesium | Lead | |
| 10 | Potassium | Manganese | |
| | | Mercury | |
| | Physical Properties | Molybdenum | |
| 11 | Conductivity | Nickel | |
| 12 | pH | Selenium | |
| 13 | Total Dissolved Solids (TDS) | Silver | |
| | | Uranium | |
| | | Vanadium | |
| 31 | | Zinc | |

Source: (Powertech, 2011a)

34 total constituents

**Monitoring constituent comparison**

| Table 5.7-2 NRC SER<br>Table 7.3-1 NRC SEIS<br>NRC Background | TR RAI June 2011<br>Table 6.1-1<br>NRC Stability Monitoring | Current EPA | MCL/HA<br>(MCL-based) | laboratory analysis cost for<br>NRC analytes |
|---|---|---|---|---|
| pH (1) | (same) | pH (1) | field | |
| SC (2) | | SC (2) | field | |
| | | | | |
| TDS (3) | | TDS (3) | | WY DEQ GL8-$363.70 |
| | | Turbidity (4) | field | |
| | | Temperature (5) | field | |
| | | D.O. (6) | field | |
| | | ORP (delete) | | |
| | | $CO_2$ (7) | calculated | |
| | | TOC (8) | | |
| | | DOC (9) | | |
| Alkalinity (as CaCO3) (4) | | Total alkalinity (10) | Total alkalinity | |
| Bicarbonate alkalinity (5) | | Bicarbonate alkalinity (11) | | WY DEQ GL8 |
| Carbonate alkalinity (6) | | Carbonate alkalinity (12) | | WY DEQ GL8 |
| Ca (7) | | Ca (13) | | WY DEQ GL8 |
| Cl (8) | | Cl (14) | | WY DEQ GL8 |
| Mg (9) | | Mg (15) | | WY DEQ GL8 |
| NO3 (10) | | NO3 (16) | 10 mg/L | WY DEQ GL8 |
| | | NO2 (17) | 1 mg/L | WY DEQ GL8 |
| Na (11) | | Na (18) | | WY DEQ GL8 |
| K (12) | | K (19) | | WY DEQ GL8 |
| | | Si (20) | | |
| | | | | |
| SO4 (13) | | SO4 (21) | 250 mg/L | WY DEQ GL8 |
| | | Al (22) | | WY DEQ GL8 |
| As (14) | As | As (23) | 0.01 mg/L | WY DEQ GL8 |
| Ba (15) | Ba | Ba (24) | 2 mg/L | WY DEQ GL8 |
| B (16) | | B (25) | 7 | WY DEQ GL8 |
| | | Be (27) | | |
| Cd (17) | Cd | Cd (27) | Cd | WY DEQ GL8 |

| | |
|---|---|
| Cr (18) | Cr |
| Cu (19) | |
| Fl (20) | |
| | |
| Fe (21) | |
| Pb (22) | |
| Mn (23) | |
| Hg (24) | Hg |
| Mo (25) | |
| Ni (26) | |
| | |
| Se (27) | Se |
| Ag (28) | Ag |
| | |
| | |
| U (29) | |
| V (30) | |
| Z (31) | |
| Gross alpha (32) | Gross alpha |
| Gross beta (33) | |
| Ra-226 (34) | Ra-226 |
| | Ra-228 |

| | | |
|---|---|---|
| Cr (28) | Cr | WY DEQ GL8 |
| Cu (29) | Cu | WY DEQ GL8 |
| Fl (30) | 4 mg/L | WY DEQ GL8 |
| Fe (31) | | WY DEQ GL8 |
| Fe (ferrous) (32) | | WY DEQ GL8 |
| Pb (33) | Pb | WY DEQ GL8 |
| Mn (34) | | WY DEQ GL8 |
| Hg (35) | Hg | WY DEQ GL8 |
| Mo (36) | | WY DEQ GL8 |
| Ni (37) | | WY DEQ GL8 |
| Sb (38) | | TA |
| Se (39) | Se | WY DEQ GL8 |
| Ag (40) | | TA |
| Sr (41) | | |
| Tl (42) | Tl | TA |
| U (43) | U | inlcuded in rads or metals |
| V (44) | | $18.00 |
| Zn (45) | | WY DEQ GL8 |
| Gross alpha (46) | Gross alpha | $288 for the rads |
| Gross beta (47) | Gross beta | |
| Ra-226 (48) | Ra-226 | |
| | Ra-228 | |

34 parameters

48 parameters

22 parameters

41 parameters

The 14 additional analyties include

| | |
|---|---|
| 1. Turbidity | field measurement |
| 2. Temperature | field measurement |
| 3. DO | field measurement |
| 4. CO2 | calculated from other analyses |
| 5. TOC | $30 |
| 6. DOC | $50 |

| | | | | | |
|---|---|---|---|---|---|
| 7. NO2 | combine with NO3 | | | | |
| 8. Silica | $17 | | | | |
| 9. Ferrous Iron | $17 | | | | |
| 10. Aluminum | included 200.8 | | | | |
| 11. Antimony | included 200.8 | | | | |
| 12. Beryllium | included 200.8 | | | | |
| 13. Strontium | included 200.8 | | | | |
| 14. Thallium | included 200.8 | | | | |
| | additional cost= | | $114 | x 2482 | $282,948 |
| 15.Radium 228 | | 104.79 | $219 | x 2482 | $543,037 |

initial samples Ra-228

| Estimates analytical cost for NRC list: | |
|---|---|
| WY DEQ GL8- | $364 |
| rads | $288 |
| vanadium | $18 |
| | $670 |

| | | |
|---|---|---|
| Wyoming DEQ<br>Well Monitoring<br>Guideline #8 (2005) | (pH & conductivity should be measured in the field at time of collection)<br>TDS, calculated charge balance, bicarbonate, carbonate,<br>Fluoride, chloride, nitrite, nitrate, sulfate, ammonia<br>As-received metals (B)<br>Total metals (Fe, Mn)<br>Dissolved metals<br>(Ca, Fe, Mg, Na, K, Ba, Al, Cr, Ni, Cu, Zn, As, Se, Mo, Cd, Hg, Pb) | $363.00 for 1-3 Samples<br>10% discount for<br>4+ samples |

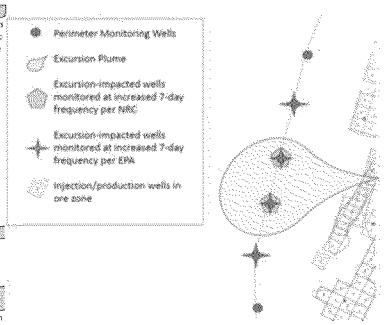
| Test Analyte/Parameter | |
|---|---|
| Bulk Properties | pH<br>Total Dissolved Solids (TDS)<br>Conductivity |
| Cations/Anions | Bicarbonate Alkalinity (as $CaCO_3$)<br>Calcium, Ca<br>Carbonate Alkalinity (as $CaCO_3$)<br>Chloride, Cl<br>Magnesium, Mg<br>Nitrate, $NO_3^-$ (as Nitrogen)<br>Potassium, K<br>Sodium, Na<br>Sulfate, $SO_4$<br>Total Alkalinity (as $CaCO_3$) |
| Trace Metals | Arsenic, As<br>Barium, Ba<br>Boron, B<br>Cadmium, Cd<br>Chromium, Cr<br>Copper, Cu<br>Fluoride, F<br>Iron, Fe<br>Lead, Pb<br>Manganese, Mn<br>Mercury, Hg<br>Molybdenum, Mo<br>Nickel, Ni<br>Selenium, Se<br>Silver, Ag<br>Uranium, U<br>Vanadium, V<br>Zinc, Zn |

| | |
|---|---|
| Radionuclides | Gross Alpha=Alpha Particles<br>Gross Beta=Beta Particles and Photons<br>Radium, Ra-226 |
| *All metals analyses are for dissolved metals.<br>Source: NRC (2003); Powertech (2011). | |

| | | |
|---|---|---|
| Target Analyte – Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, Zn | 200.8 / 6020 | $267.00 |

without radium 228
with radium 228

| NRC License Requirements | Class III Permit Requirements | Extra Burden | Alternative |
|---|---|---|---|
| List of Baseline Water Quality Parameters | List of Water Quality Parameters | Additional analytes under Class III Permit | Number of additional analytes under the Class III Permit |
| 37 analytes | 46 analytes | 11 additional analytes:<br>Temperature<br>Dissolved Oxygen<br>Oxidation-Reduction Potential<br>CO2<br>Total Organic Carbon<br>Dissolved Organic Carbon<br>Silica<br>Aluminum<br>Specific gravity<br>Turbidity<br>Radium-228 | we could remove 2 parameters: SG and Radium-228 |
| Geochemical Model Development | Geochemical Model Development | Geochemical Model Development | |
| Three Scenarios requiring Geochemical Modeling | Three Scenarios requiring Geochemical Modeling | Three Scenarios requiring Geochemical Modeling | |
| 1. All ISR contaminants restored to pre-mininning concentrations: | 1. All ISR contaminants restored to pre-mininning concentrations: | 1. All ISR contaminants restored to pre-mininning concentrations: | |
| No equivalent requirement<br>The NRC relies on monitoring within the injection zone | Reactive Transport Model to demonstrate long term geochemical stability for 14 wellfields. | Powertech would need to compile at least 6 geochemical models for the Wellfield Closure Plan it proposed. These models include 1 model for each of the three proposed injection intervals at the Dewey and the Burdock sites.<br><br>Under the Class III permit, the timing for the model begins during stability monitoring of first wellfield being closed instead of at the end of the project as Powertech proposed.<br><br>The difference between Powertech's proposed modeling scenario and the Class III permit scenario is actually only 8 models that need to be developed. The Class III permit probably requires a higher level of effort for the uncertainty analysis than Powertech would have done on its own. | |
| 2. For License Modification Application to approve Alternate Concentration Limit | 2. An Alternative Concentration Limit is needed for one ore more ISR contaminants | 2. An Alternative Concentration Limit is needed for one ore more ISR contaminan | |
| ACL application would involve geochemical modeling | Same requirement as ACL application for NRC license, except the Class III Permit also requires a highere level of effort for the quantitative uncertainty anlyses than we observed in the two ACL applications we reviewed for ISR projects in WY. | The additional burden under the Class III permit includes more rigorous evaluation of model calibration and uncertainty analysis of model results. | |
| 3. Expanding Excursion Plume | 3. Expanding Excursion Plume | 3. Expanding Excursion Plume | |
| No equivalent requirement. However for an excursion that is not corrected within 60 days of confirmation, the licensee shall either (a) terminate injection of lixiviant within the wellfield until the excursion is corrected; or (b) increase the surety in an amount to cover the full third-party cost of correcting and cleaning up the excursion. The surety increase shall remain in force until the NRC has verified that the excursion has been corrected and remediated. | Expanding Excursion Plume:<br>Reactive Transport Model to evaluate mobility of contaminants and natural attenuation capability of the downgradient aquifer. | Powertech has stated they are not aware of any ISR operation detecting data that fits the permit criteria of expanding excursion plume.<br>These requirement will probably never have to be implemented, except in an extrem and unlikely case. These requirements serve as assurance for the concerned public. | |
| Monitoring of Confirmed Excursion Plume | Monitoring of Confirmed Excursion Plume | Monitoring of Confirmed Excursion Plume | |
| 15-day interval monitoring of perimeter monitoring wells i increased to 7-day interval for monitoring wells impacted by confirmed excursion | From 15-day to 7-day interval monitoring of wells impacted by confirmed excursion and the two unimpacted wells bracketing confirmed excursion plume (see figure to right | For each excursion, two additional wells monitored every 7 days instead of every 15 days for three constituents : specific conductance, total alkalinity and chloride | |
| Monitoring of Expanding Excursion Plume | Monitoring of Expanding Excursion Plume | Monitoring of Expanding Excursion Plume | |
| Not included<br>Instead requirement is if an excursion is not corrected within 60 days of confirmation, the licensee shall either (a terminate injection of lixiviant within the wellfield until the excursion is corrected; or (b) increase the surety in an amount to cover the full third-party cost of correcting and cleaning up the excursion. The surety increase shall remain in force until the NRC has verified that the excursion has been corrected and remediated. The written 60-day excursion report shall identify which course of action the licensee is taking. Under no circumstances does this condition eliminate the requirement that the licensee remediate the excursion to meet groundwater protection standards as required by LC 10.6 for all constituents established per LC 11.3. | Collect samples weekly from impacted monitoring wells.<br>Analyse first sample for all WQ parameters and continue to analyze monthly samples for all WQ paramters.<br>Develop Groundwater model | Powertech has stated they are not aware of any ISR operation detecting data that fits the permit criteria of expanding excursion plume, so this requirement is for assuranc of concerned public and will probably never have to be implemented, except in case of extreme conditions. | |
| Operational Montioring of Private Well | Operational Montioring of Private Well | Operational Montioring of Private Well | |
| Licence says Annually for all Baseline Parameters<br>Safety Evaluation Reports says Quarterly | Permit says Quarterly for all Water Quality Parameters | 3 additional quarterly samples per year for all water quality parameters | |
| Excursion Montioring during the Post-Restoration Stability Monitoring Phase | Excursion Montioring during the Post-Restoration Stability Monitoring Phase | Excursion Montioring during the Post-Restoration Stability Monitoring Phas | |
| License says excursion montioring during ISR operation. Safety Evaluation Report and Powertech Technical Evaluation Report for NRC License say there is excursion monitoring during this phase. | Excursion monitoring is required during the Stability Montioring Phase | 60-day interval monitoring of the 3 excursion parameters for all perimeter monitorin wells plus overlying and underlying monitoring wells during a minimum of 5 sampling events bracketing 4 quarters. | |
| The NRC License has a more rigorous requirement for Powertech to attempt to locate and properly abandon all historic drill holes located within the perimeter well ring for each wellfield prior to conducting tests for a wellfield data package. | Requirement in Class III permit is to attempt to locate and properly abandon all historic boreholes within the permimeter monitoring well ring during the aquifer pump test required for the wellfield data package | Requirements related to location and plugging of improperly plugged boreholes | |
| The Atomic Safety and Licensing Board amended the NRC License with a condition similar to one included in the Strata license in WY:<br>Prior to conducting tests for a wellfield data package, the licensee will attempt to locate and properly abandon all historic drill holes located within the perimeter well ring for the wellfield. The licensee will document, and provide to the NRC, such efforts to identify and properly abandon all drill holes in the wellfield data package | The EPA believes the Permittee has already done due diligence in characterizing any improperly plugged historic exploratory boreholes that are evident at the ground surface. No further characterization is possible until the wellfield pump tests are conducted to identify breaches in the Fuson Shale confining zone. Wellfiled pump tests are also required under the license, so there is no additional burden under this permit requirement. | In this case, the requirement in the Class III Permit is less burdensome than the license. | |



| Wellfield | Injection Interval | Ore Length (ft) | Ore Width (ft) | Perimeter (ft) | Ore Area ($ft^2$) |
|---|---|---|---|---|---|
| B1 | L/M Chilson | 5000 | 575 | 14350 | 2875000 |
| B2 | L/M Chilson | 4250 | 300 | 12300 | 1275000 |
| B3 | Upper Chilson | 2250 | 200 | 8100 | 450000 |
| B4 | L/M Chilson | 7750 | 250 | 19200 | 1937500 |
| B5 | Upper Chilson | 4750 | 200 | 13100 | 950000 |
| B6 | L/M Chilson | 9500 | 600 | 23400 | 5700000 |
| B7 | L/M Chilson | 4000 | 250 | 11700 | 1000000 |
| B8 | L/M Chilson | 3375 | 2750 | 15450 | 9281250 |
| B9 | L/M Chilson | 2000 | 200 | 7600 | 400000 |
| B10 | Lower Fall River | 1000 | 200 | 5600 | 200000 |
| D1 | Lower Fall River | 5000 | 1000 | 15200 | 5000000 |
| D2 | L/M Chilson | 6150 | 200 | 15900 | 1230000 |
| D3 | Lower Fall River | 2500 | 200 | 8600 | 500000 |
| D4 | Upper Chilson | 3500 | 200 | 10600 | 700000 |

| Calculate Area with Allumium | | | | | |
|---|---|---|---|---|---|
| Wellfield | Injection Interval | Ore Length (ft) | Ore Width (ft) | | Alluvium Area ($ft^2$) |
| B1 | L/M Chilson | 5000 | 575 | none | none |
| B2 | L/M Chilson | 1750 | 300 | | 525000 |
| B3 | Upper Chilson | 2250 | 200 | none | none |
| B4 | L/M Chilson | 2000 | 250 | | 500000 |
| B5 | Upper Chilson | 4750 | 200 | all | 950000 |
| B6 | L/M Chilson | 9500 | 600 | none | none |
| B7 | L/M Chilson | 4000 | 250 | none | none |
| B8 | L/M Chilson | 1500 | 200 | | 300000 |
| B9 | L/M Chilson | 2000 | 200 | all | 400000 |

| | | | | | |
|---|---|---|---|---|---|
| B10 | Lower Fall River | 1000 | 200 | all | 200000 |
| D1 | Lower Fall River | 2250 | 1000 | | 2250000 |
| D2 | L/M Chilson | 6750 | 200 | | 1350000 |
| D3 | Lower Fall River | 2500 | 200 | all | 500000 |
| D4 | Upper Chilson | 1250 | 200 | | 250000 |

| Wellfield # | # CAB wells | |
|---|---|---|
| B-1 | 17 | |
| B-2 | 7 | |
| B-3 | 3 | |
| B-4 | 11 | |
| B-5 | 5 | |
| B-6 | 33 | |
| B-7 | 6 | |
| B-8 | 53 | |
| B-9 | 2 | |
| B-10 | 1 | |
| D-1 | 29 | |
| D-2 | 7 | |
| D-3 | 3 | |
| D-4 | 4 | |
| | 180.778 | 181 |

No previous analytical results from 10 of the 30

Number of samples analyzed for Table 8 param
Initial sample from each excursion monitoring v
4 quarters, 10 operational monitoring wells
CAB wells, 4 initial samples
CAB wells, 5 stability monitoring samples

List of operational monitoring wells
11 alluvial wells
9 Fall River wells
8 Chilson wells
3 Unkpapa wells

total wells:
analytical cost for EPA analytes/sample:
annual cost (4 samples/year)

| # PMWs | Acres | # MO1 wells | # MU wells | # MO2 wells | # MO3 wells | #MO4 wells |
|---|---|---|---|---|---|---|
| 34 | 66.0 | 17 | 0 | 8 | 8 | |
| 29 | 29.3 | 7 | 0 | 4 | 4 | |
| 18 | 10.3 | 3 | 3 | 1 | 0 | |
| 46 | 44.5 | 11 | 0 | 6 | 6 | 6 |
| 31 | 21.8 | 5 | 5 | 3 | 0 | |
| 57 | 130.9 | 33 | 0 | 16 | 16 | |
| 27 | 23.0 | 6 | 0 | 3 | 3 | |
| 37 | 213.1 | 53 | | 27 | 27 | |
| 17 | 9.2 | 2 | 0 | 1 | 1 | |
| 12 | 4.6 | 1 | 1 | 0 | 0 | |
| 36 | 114.8 | 29 | 29 | 0 | 0 | |
| 38 | 28.2 | 7 | 0 | 4 | 4 | |
| 20 | 11.5 | 3 | 3 | 0 | 0 | |
| 25 | 16.1 | 4 | 4 | 2 | 0 | |
| 425 | | 181 | 45 | 74 | 69 | |

DGCB

| | |
|---|---|
| Lower Fall River | |
| Upper Fall River | |
| Middle Chilson | |
| Upper Chilson | |

| | # Acres of alluvium | # alluvial wells |
|---|---|---|
| done | | 0 |
| done | 12.0523416 | 2 |
| done | | 0 |
| done | 11.47842057 | 1 |
| done | 21.80899908 | 3 |
| done | | 0 |
| done | | 0 |
| done | 6.887052342 | 1 |
| done | 9.182736455 | 1 |

| alluvium | |
|---|---|

| | |
|---|---|
| MO1 wells | 181 |
| MO2 | 74 |
| MO2 | 69 |
| MU | 45 |
| alluvial wells | 21 |
| | 390 |
| # PMW | 425 |
| | 815 |

| | | | |
|---|---|---|---|
| done | 4.591368228 | 1 | |
| done | 51.65289256 | 6 | |
| done | 30.99173554 | 4 | |
| done | 11.47842057 | 1 | |
| done | 5.739210285 | 1 | |
| | | 21 | alluvial wells |

l operational montioring wells:

| | | | # samples w/ radium | # samples w/o radium | | |
|---|---|---|---|---|---|---|
| eters | | | | | | |
| vell | | 815 | 815 | 0 | | |
| | | 40 | 10 | 30 | | |
| | 724 | 723 | 180 | 540 | | |
| | 905 | 904 | 180 | 720 | | |
| | | 2482 | 1185 | 1290 | | |
| | | $ 219.00 | $ 219.00 | $114 | | |
| | | $ 543,558.00 | $ 259,515.00 | $147,060 | $ 406,575.00 | new cost |
| | | this is Powertech's estimate for analysis of the extra EPA analytes | | | | |
| | | but I need to add in the quarterly analysis of operational moniting wells & private wells | | | | |
| | | 3 private wells | | | | |
| | | annual monitoring | $ 657.00 | for just the EPA analytes | | |
| | 31 | 3 additional quarters | $ 8,001.00 | for all analytes (NRC+EPA) | NRC analyte cost: $670 | |
| $ | 6,789.00 | | $ 8,658.00 | annual cost | see Analyte Comparison worksheet | |
| $ | 27,156.00 | total aanual cost: | $ 35,814.00 | | | |
| | | | | | NRC+EPA list | $ 889.00 |

| # total excursion monitoring wells | # 100' by 100' wellfield patterns | well count |
|---|---|---|
| 67 | 287.5 | 574 |
| 45 | 127.5 | |
| 25 | 45 | |
| 70 | 193.75 | |
| 47 | 95 | |
| 122 | 570 | |
| 39 | 100 | |
| 144 | 928.125 | |
| 23 | 40 | |
| 15 | 20 | |
| 100 | 500 | |
| 56 | 123 | |
| 27 | 50 | |
| 35 | 70 | |
| 814 | 0 | |

non-inj zone wells
PMW
# excursion monitoring wells

| Wellfield | Injection Interval | Ore Length (ft) | Ore Width (ft) | Perimeter MRW (ft) | Ore Area ($ft^2$) |
|---|---|---|---|---|---|
| B-WF1 | L/M Chilson | 5000 | 575 | 14350 | 2.88E+06 |
| B-WF2 | L/M Chilson | 4250 | 300 | 12300 | 1275000 |
| B-WF3 | Upper Chilson | 2250 | 200 | 8100 | 450000 |
| B-WF4 | L/M Chilson | 7750 | 250 | 19200 | 1937500 |
| B-WF5 | Upper Chilson | 4750 | 200 | 13100 | 950000 |
| B-WF6 | L/M Chilson | 9500 | 600 | 23400 | 5700000 |
| B-WF7 | L/M Chilson | 4000 | 250 | 11700 | 1000000 |
| B-WF8 | L/M Chilson | 3375 | 2750 | 15450 | 9281250 |
| B-WF9 | L/M Chilson | 2000 | 200 | 7600 | 400000 |
| B-WF10 | Lower Fall River | 1000 | 200 | 5600 | 200000 |
| D-WF1 | Lower Fall River | 5000 | 1000 | 15200 | 5000000 |
| D-WF2 | L/M Chilson | 6150 | 200 | 15900 | 1230000 |
| D-WF3 | Lower Fall River | 2500 | 200 | 8600 | 500000 |
| D-WF4 | Upper Chilson | 3500 | 200 | 10600 | 700000 |

| 1.2% ore area ($ft^2$) | how many feet does that add in each direction? | new total area ($ft^2$) | compare area |
|---|---|---|---|
| 3.45E+04 | 7 | 2.91E+06 | 2.91E+06 |
| 12750 | 113 | 1.29E+06 | 1.80E+06 |
| 4500 | 67 | 4.55E+05 | |
| 19375 | 139 | 1.96E+06 | |
| 9500 | 97 | 9.60E+05 | |
| 57000 | 239 | 5.76E+06 | |
| 10000 | 100 | 1.01E+06 | |
| 92812.5 | 305 | 9.37E+06 | |
| 4000 | 63 | 4.04E+05 | |
| 2000 | 45 | 2.02E+05 | |
| 50000 | 224 | 5.05E+06 | |
| 12300 | 111 | 1.24E+06 | |
| 5000 | 71 | 5.05E+05 | |
| 7000 | 84 | 7.07E+05 | |

Cadmus Hrly Rates

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 22 | | | | | | | | | | |
| P2 | 23 | | | | | | | | | | |
| P3 | 30 | | | | | | | | | | |
| P4 | 53 | | | | | | | | | | |
| 1 year | 2080 | hrs | | $ 110,240.00 | | | $ 36,746.67 | | | Powertech's approach | |
| 9 months | 1560 | | | $ 200,000.00 | lab testing | | $ 200,000.00 | | | $ 310,240.00 | first model |
| 6 months | 693 | | | $ 310,240.00 | 1st L/M Chilson model | | $ 236,746.67 | 1st model | | $186,144 | next wellfield |
| lab testing per wellfield | $200,000 | | | $227,560 | next L/M Chilson wellfield | | $ 2,743,312.00 | 13 more models | | $744,576 | 4 more wellfields |
| 1st model | 400,000 | | | $ 1,365,360.00 | plus 6 more L/M Chilson wellfields | | $ 2,980,058.67 | total | | $930,720 | |
| next model | 120000 | | | $ 293,072.00 | 1st Upper Chilson model | | | | | | |
| | | | | $ 455,120.00 | Plus 2 more Upper Chilson models | | | | | | |
| $324,400,000.00 | divided by 17 yrs | $19,082,352.94 | | $ 293,072.00 | 1st Fall River model | | | | | | |
| | | | | $227,560 | plus 1 more Fall River model | | | | | | |
| | | | | $ 3,171,984.00 | | | | | | | |
| $1,520,176 | per wellfield | $108,584 | | | | | | | | | |
| Expanding plume analysis cost | 3 wells for one year= | $ 4,104.00 | | | | | | | | | |
| | 1 well for one year= | $ 1,368.00 | | | | | | | | | |

The total uranium production as U3O8 over the life of the Project is estimated to be 14.268 million pounds.
from Report
Effective date: December 3, 2019
Report Date: January 17, 2020
An economic analysis has been performed based on the current Project uranium production estimates using the production schedule in conjunction with the estimated recoverable resource of 14.268 million pounds3 as discussed in Section 17.

This analysis also assumes a constant price of $55.00 per pound for U3O8 over the life of the Project. The calculated cost per pound of uranium produced is $28.88 including all costs, with an estimated direct cash operating costs of $10.46 per pound of U3O8 (Pre-U.S. federal income tax) and an estimated "all in cost" of approximately $32.27 (Post-U.S. federal income tax) per pound of U3O8.

| | | |
|---|---|---|
| $ | 326.45 | 14.268 million pounds x $22.88 per pound |
| $ | 19.20 | over 17 years of ISR operations |
| | $89,422 | annual modeling costs over 17 years |
| | 0.046574% | |

| Wellfield | Years from construction through end of GW Restoration (2015 PEA) | Post-restoration monitoring timeframe | Total years of DGCB monitoring |
|---|---|---|---|
| B-1 | 4.5 | 10 | 14.5 |
| B-2 | 2 | 10 | 12 |
| B-3 | 1.25 | 10 | 11.25 |
| B-4 | 1.75 | 10 | 11.75 |
| B-5 | 1.75 | 10 | 11.75 |
| B-6 | 3.25 | 10 | 13.25 |
| B-7 | 1.25 | 10 | 11.25 |
| B-8 | 1.5 | 10 | 11.5 |
| B-9 | 3.5 | 10 | 13.5 |
| B-10 | 1.5 | 10 | 11.5 |
| D-1 | 5.25 | 10 | 15.25 |
| D-2 | 3.5 | 10 | 13.5 |
| D-3 | 2 | 10 | 12 |
| D-4 | 2.25 | 10 | 12.25 |
| | | total years of monitoring | 175.25 |
| # DGCB wells | | | 701 |
| Dewey Area | 14,000 ft / 1 well every 400 ft | 35 | |
| Burdock Area | #PMRWs | 0 | DGCB ft |
| B-1 | 34 | 13 | 5,000 |
| B-2 | 29 | 15 | 6,000 |
| B-3 | 18 | 0 | |
| B-4 | 46 | 8 | 3000 |
| B-5 | 31 | 16 | |
| B-6 | 57 | 18 | 7000 |
| B-7 | 27 | 8 | 3250 |
| B-8 | 37 | 18 | 7000 |
| B-9 | 17 | 0 | |
| B-10 | 12 | 6 | |
| | | 135 | total DGCB wells |

4 quarterly samples per year

| | | |
|---|---|---|
| 58 | | Cost per sample for NRC analytes $670 |
| 48 | | #samples |
| 45 | | 4 samples 815 excursion monitroing wells |
| 47 | | 4 initial samples 181 CAB wells |
| 47 | | 5 stability monitoring samples CAB wells |
| 53 | | 4 initial samples 10 operational monitoring wells |
| 45 | | |
| 46 | | |
| 54 | | |
| 46 | | |
| 61 | | |
| 54 | | |
| 48 | | PT's cost estimate for EPA monitoring |
| 49 | | 2482 samples * $219 $ 543,558.00 |
| 701 | samples collected | 31 operational monitoring wells + 3 private wells monitor |
| 701 samples for 135 wells | 94723 | 12.75 yrs operational monitoring |
| cost per sample: | $ 127.77 | cost per year from Wellfield Measurements tab |
| cost based on my estimate | | multiply 12.75 years of operational monitoring |
| or NRC+EPA list | $ 84,208,413.63 | |

PT additional cost for EPA requirements

PT estimated analytical cost
incl DGCB
subtract cost for EPA requirements
to get cost for DGCB well monitoring

| | |
|---|---|
| Analysis of cost for expanding excursion plume | |
| cost for whole analyte list NRC + EPA | $ EPA list $114 |
| EPA list with Radium | |
| EPA list without Radium | |
| | |
| expanding excursion plume costs | |
| per well per year | initial sample wit |
| 11 months without radium | |
| | |
| for an injection zone expanding plume 2 wells impacted: | |

| | |
|---|---|
| total cost: | $3,302,430 |

| | |
|---|---|
| | 3260 |
| | 724 |
| | 905 |
| | 40 |
| total # samples | 4929 |

| |
|---|
| with radium 228 |
| red quarterly |
| $35,814.00 |
| $456,628.50 |
| $1,000,186.50 |

| |
|---|
| $ 13,102,600.00 |
| $1,000,187.00 |
| $ 12,102,413.00 |

| | |
|---|---|
| | |
| w/ radium 228= | $219 |
| $ 889.00 | |
| $ 784.00 | |
| | |
| | |
| h radium | $ 889.00 |
| | $ 8,624.00 |
| | $ 9,513.00 |
| | $ 19,026.00 |